and WBC (r = 0.95, p < 0.001), and [Osm] and Plat (r = 0.94, p < 0.01), indicate that the leucocytes, thrombocytes, and hyperosmolality occur primarily within the first 10 minutes of moderate (71% of the maximal intensity) exercise. Neither the decrease in PV nor the increase in Tre during exercise, as shown in part (b) of the figure, were involved because all respective correlation coefficients between percent change in PV and Tre and WBC, Plat, and [Osm] were less than 0.2 (nonsignificant).

Thus, these high correlations, between [Osm] and WBC or Plat, suggest the hypothesis that changes in plasma osmolality may contribute to the mechanism of leucocytosis and thrombocytosis induced by exercise.

Point of Contact: J. Greenleaf
(650) 604-6604
jgreenleaf@mail.arc.nasa.gov

Neurolab Technologies Enable Space Life Sciences Neuroscience Research

James P. Connolly, Paul D. Savage

The Shuttle Spacelab mission, Neurolab, was the primary focus for the flight support elements of the Life Sciences Division, the Payload and Facilities Engineering Branch, and the Science Payloads Operations Branch. First conceived in 1993, and launched just five years later, Neurolab evolved into the most complex Spacelab mission ever developed by Ames Research Center (ARC). Though the major hardware units had flown previously (for example, the general purpose work station (GPWS), the research animal holding facilities (RAHFs), and the animal enclosure modules (AEMs)), critical modifications were carried out to ensure that the hardware would meet the Neurolab science objectives and improve overall technical capabilities.

The monitoring and process control subsystem (MPCS) was a new element incorporated into the RAHFs. The MPCS is a microprocessor-based process and control system housed in a standard interface rack (SIR) drawer. It replaces both the RAHF upper and lower electronic boxes used on previous flights for environmental system control, RAHF system monitoring, and data retrieval. Consolidation of these functions into a single unit was intended to improve maintainability, increase thermal and power efficiency, add system diagnostic capabilities, improve remote ground monitoring and control, and reduce the overall required rack space. Additionally, incorporation of the MPCS in the SIR drawer ensured its compatibility with future International Space Station experimental systems. Because the Neurolab science objectives required the housing of neonate rats, some RAHF cages were modified to accommodate nursing dams and neonates. A middeck flight with rat neonates on STS-72 in January 1996 was a research "first" by the Ames Life Sciences Division that helped prepare for the sophisticated experiments on Neurolab.

The AEMs, which were previously flown on 20 Shuttle missions and designed for hands-off protocols, were modified for in-flight access to animals. Access and transfer schemes proposed for use on Neurolab were first tested in the parabolic arc environment aboard a KC-135. The AEM lid and transfer unit modifications greatly expanded the science that is possible using this middeck rodent facility (see the first figure). The improved AEM may

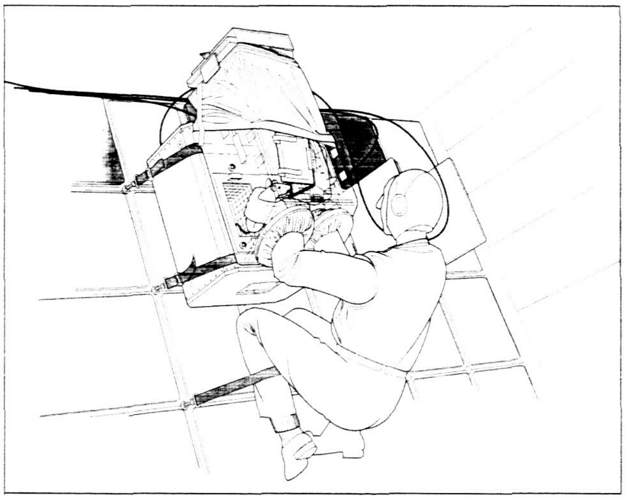

Fig. 1. Crew person at animal enclosure module with modified lid and transfer unit allowing middeck animal access.

well be the mainstay of the life sciences microgravity experiments in the shuttle middeck while the Space Station is being assembled.

Unique flight hardware, designed to support specific experiments on the Neurolab Mission, includes the Neurolab biotelemetry system (NBS) and a sophisticated system to measure and record neural coding signals of place and direction in the microgravity environment. The NBS, based on commercially available hardware, was developed to monitor heart rate, deep body temperature, and activity for 12 rats housed in one of the payload's two RAHF systems (see second figure). The hardware that measures and records neural codings monitored the performance of freely behaving rats on specialized experiment apparatuses during testing sessions inside the GPWS.

Fig. 2. Ensemble neural coding of place and direction in Zero-G experimental animal, with associated test hardware.

ARC's engineering, science, and operations personnel have successfully managed hardware development, functional testing, biocompatibility testing, and delivery of a highly complex array of flight hardware to support this last Spacelab Mission in commemoration of the "Decade of the Brain."

Point of Contact: J. Connolly/P. Savage
(650) 604-6483/5940
jpconnolly@mail.arc.nasa.gov
psavage@mail.arc.nasa.gov

Advanced Life Support Research and Technology Development Activities

Mark Kliss

Ames Research Center carries out research and development of new technologies that will enable the human exploration and development of space. These activities will reduce life-cycle costs, improve operational performance, promote self-sufficiency, and minimize the expenditure of resources in future space exploration, such as a human mission to Mars. Advanced Life Support technologies for a human Mars mission are depicted in the figure. There are also significant opportunities for Earth application of the developed technologies. The following are some of the key examples of these activities.

Power consumption is a key problem facing carbon dioxide (CO_2) removal technologies for long-duration spaceflight. There are problems with efficiency in using the current sorbent-based techniques to perform the carbon dioxide/water (CO_2/H_2O) split. This research seeks to develop high-efficiency CO_2 removal technologies for closed-loop regenerative systems by improving the CO_2/H_2O separation. Data on the influence of water on the adsorption of CO_2 and trace contaminants show significant reduction in the capacity of sorbents and the possibility of elution back into the cabin environment. In FY97, research on new materials and operating procedures has made significant contributions toward mitigating this safety problem. New knowledge on adsorption processes has also led to a novel passive/low-power method of extracting and pressurizing a nitrogen-argon mixture from the Martian atmosphere. This mixture would be suitable as a carrier/sweep gas for instruments used on planetary probes.

In situ resource utilization (ISRU) is an enabling technology for both robotic and human missions. In robotic missions, the in situ production of consumables from local resources (carrier gas,